Amendments to the Specification:

The paragraphs that were presented between page 1, line 1, and page 3, line 12, of the original application will be deleted and will be replaced with newly added paragraphs as follows:

~~Description~~

~~A METHOD OF PRODUCIG HONEYCOMB STRUCTURE~~

~~Technical Field~~

~~The present invention relates to a honeycomb structure that is formed using a press with a die to make two metal plates (2, 6) which have hexagonal pegs positioned at a certain distance from each other, and these plates are joined together into a complete honeycomb structure.~~

~~Description of Drawings~~

~~FIG 1 is the position of hexagonal cells on the metal plate A;~~

~~FIG 2 is the position of hexagonal cells on the metal plate B;~~

~~FIG 3 shows position of hexagonal cells on both metal plate A and B when one plate is overlapping the other;~~

~~FIG 4 is the metal plate A with hexagonal pegs formed by a press~~

~~FIG 5 is the metal plate B with hexagonal pegs formed by a press~~

~~FIG 6 is the honeycomb structured block in which metal formed plates are joined together.~~

~~FIG 7 is showing a method of extending the total size of the core block by joining the honeycomb blocks in a zigzag manner.~~

~~FIG 8 is showing a method of making honeycomb sandwich panel attaching non-woven fabric and face sheets on a core.~~

<Description of the numbers on drawing>

2. Metal plate A

4. Position of the hexagonal cells on metal pate A

6. Metal plate B

8. Position of the hexagonal cells on metal plate B

10. Metal plate A + B

12. Position of the hexagonal cells that are made automatically

14. Hexagonal peg

16. Hexagonal cell

18. Hexagonal cells that are made automatically

20. Honeycomb block A

22. Honeycomb block B

24. Non-woven fabric

26. Face sheet

Technical Problems

Unlike the existing methods, the present invention is using a press to form a honeycomb structure out of many different types of metal plate. However, it seems it is very difficult or impossible to form a honeycomb structure with a single process using a press, because the hexagonal cells wit the structure are placed right next to each other sharing the very thin cell walls among them.

Technical Solutions

In the present invention, a die is needed to be built for the making of hexagonal cells of the honeycomb structure. Honeycomb structure consists of many hexagonal cells lined up continuously but because the cell walls are so thin, it is nearly impossible to form the structure with a press and a single die in one step. In the present invention, however, a die is designed and the hexagonal cells on the die are placed at a certain distance from each other, as showing in FIG 1 and FIG 2, so that when the cell positions from those to FIGs are overlapping, the result is a perfect honeycomb shape as shown in FIG 3. This die and a

press are used to change the shape of two thing metal plates (2, 6) shown in FIG 1 and FIG 2, into two formed metal plates which have hexagonal pegs (14) protruding out as shown in FIG 4 and FIG 5. And then, in order to make a shape of honeycomb structure, these two formed metal plates are joined together into a block, like in FIG 6, by facing the protruding sides to each other and inserting one plate's pegs (14) into the spaces among the other plate's pegs (14).

In order to have physical properties of honeycomb structure from the block described above, the hexagonal pegs have to be bonded to each other strongly. So, before joining the two formed metal plates together from the previous process, some adhesives or welding materials are inserted or applied on the outer surface of the pegs (14).

FIG 7 shows the method of extending the size of the block by joining the honeycomb blocks (20, 22) in a zigzag manner.

FIG 8 shows the making of a honeycomb sandwich panel. Face sheets (26) and adhesive are added to the top and bottom of the block. The face sheets can be made out of many different materials. Non-woven fabric (24) can be used with the adhesive to create a better bond between the sheets (26) and the block.

Advantageous Effects

In the present invention, a press and a die are used to make the process of producing honeycomb structure simpler. Also, honeycomb structure can be formed using many different types of metal that have high tensile, compression, and bending strength.

A METHOD OF PRODUCING HONEYCOMB STRUCTURE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a method for producing a honeycomb structure. More particularly, the present invention is concerned with a method of producing a honeycomb structure usable for lightweight construction materials, which involves shaping two metal plates, using a die and a press, in the form of hexagonal cell plates having uniformly-spaced protruded hexagonal pegs, overlapping the shaped hexagonal cell metal plates such that surfaces of the metal plates, from which the hexagonal pegs are protruded, face each other, and bonding the metal plates, thereby producing a honeycomb structure having firmly joined dense cells.

Description of the Background Art

In general, honeycomb structures are widely applied for lightweight materials used in structures such as buildings. As is well known, such honeycomb structures are structurally firm.

Such a honeycomb structure is a combination of numerous hexagonal cells in which the hexagonal cells are densely horizontally joined at thin cell boundaries defined by thin walls thereof. For this reason, it is very difficult to form a honeycomb structure, using a die in a single pressing process. Furthermore, it was more difficult to fabricate honeycomb structures, using various metal materials.

SUMMARY OF THE INVENTION

Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a method of producing a honeycomb structure, which includes shaping two metal plates, using a die and a press, in the form of hexagonal cell plates having protruded hexagonal pegs, overlapping the shaped hexagonal cell metal plates such that surfaces of the metal plates, from which the hexagonal pegs are protruded, face each other, and bonding the metal plates, thereby producing a honeycomb structure having firmly joined dense cells.

In accordance with the present invention, the above object can be accomplished by the provision of a method for producing a honeycomb structure, comprising the steps of: forming two hexagonal cell metal plates each having uniformly-spaced hexagonal pegs, using a die and a press; applying a fusing material or strong adhesive to outer surfaces of the hexagonal pegs; and overlapping the metal plates such that surfaces of the metal plates, from which the hexagonal pegs are protruded, face each other, and coupling the metal plates such that adjacent ones of the hexagonal pegs of the metal plates are engaged, thereby producing a honeycomb structure having continuously joined cells.

According to the present invention, the hexagonal pegs may be substituted with a pentagonal, square, triangular, or circular cross-sectional shape.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view showing the positions of hexagonal cells on a hexagonal cell metal plate A.

Fig. 2 is a plan view showing the positions of hexagonal cells on a hexagonal cell metal plate B.

Fig. 3 is a plan view showing the positions of the hexagonal cells on the metal plates A and B when the metal plate A is overlapped with the metal plate B.

Fig. 4 is a perspective view showing the structure of hexagonal pegs formed at the hexagonal cell metal plate A.

Fig. 5 is a perspective view showing the structure of hexagonal pegs formed at the hexagonal cell metal plate B.

Fig. 6 is a perspective view showing a honeycomb structure fabricated by overlapping the shaped hexagonal cell metal plates A and B.

Fig. 7 is a side view showing a method of increasing the size of the honeycomb structure by joining the shaped hexagonal cell metal plates in the manner of zigzag.

Fig. 8 is a side view showing the state in which flat plates are attached to upper and lower surfaces of the completely-fabricated honeycomb structure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Typically, a honeycomb structure is a combination of numerous hexagonal cells in which the hexagonal cells are densely horizontally joined at cell boundaries defined by thin walls thereof. For this reason, it is very difficult to form such a honeycomb structure, using a die and a press in a single pressing process.

The present invention has been made in view of the above problems, and provides a method for producing a honeycomb structure, which is characterized by preparing moulds each having hexagonal pegs arranged in a low density, shaping metal plates using the moulds such that each of the metal plates has hexagonal pegs corresponding to those of an associated one of the moulds, as shown in Figs. 4 and 5, and overlapping the shaped metal plates, as shown in Fig. 6, to form a honeycomb structure in which the hexagonal pegs of

the shaped metal plates are densely arranged. The honeycomb structure produced as described above in accordance with the present invention is considerably firm, so that the honeycomb structure can be useful for lightweight construction materials.

In accordance with the present invention, as shown in Fig. 1 and Fig. 2, moulds are first prepared which will be used to shape thin metal plates such that each of the metal plates has hexagonal pegs 4 or 8 each constituting a unit cell of a honeycomb structure to be produced. In the honeycomb structure, numerous hexagonal cells must be horizontally joined at cell boundaries defined by thin walls thereof. However, it is very difficult to form such a honeycomb structure, using a single mould in a single pressing process. To this end, in accordance with the present invention, particular moulds are designed, each of which has hexagonal pegs 4 or 8 each spaced apart from one another by an appropriate distance, as shown in Figs. 1, 2, and 3. The space between adjacent hexagonal pegs and the position of each hexagonal peg in each mould are determined so that, when two metal plates 2 and 6 shaped to have hexagonal pegs 4 or 8 by respective moulds are overlapped with each other, the hexagonal pegs 4 and 8 of the metal plates 2 and 6 are joined in the form of a honeycomb.

Using the moulds prepared as described above, thin metal plates are then shaped. As a result, as shown in Figs. 4 and 5, each shaped metal plate, that is, the metal plate 2 or 6, has hexagonal pegs 14 each constituting a unit cell of the honeycomb structure to be produced. Thereafter, the two shaped hexagonal cell metal plates 2 and 6 are overlapped such that the protruded surfaces of the metal plates 2 and 6 face each other. Thus, a honeycomb structure is completely produced, as shown in FIG. 6.

In order to enable such a honeycomb structure to be used for lightweight construction materials, the hexagonal cells of the honeycomb structure, which constitute the skeleton of the honeycomb structure, must be firmly bonded together to form an integrated structure. To this end, in accordance with the present invention, a fusing material or strong adhesive is applied to the outer surfaces of the hexagonal pegs 14 of the shaped metal plates 2 and 6, prior to the overlapping of the shaped metal plates 2 and 6. When the shaped metal plates 2 and 6 are overlapped, as shown in Fig. 6, the hexagonal pegs 14 of the shaped metal plates 2 and 6 are firmly bonded by the fusing material or

adhesive to form an integrated structure.

Furthermore, as shown in Fig. 7, the size of the honeycomb structure may be increased using a plurality of shaped metal plates, for example, by joining the shaped hexagonal cell metal plates in the manner of zigzag.

In order to enhance the connection of the hexagonal cell metal plates in the honeycomb structure produced as described above, and to improve the appearance of the honeycomb structure, flat plates 26 made of a material different from that of the hexagonal cell metal plates may be attached to the upper and lower surface of the honeycomb structure. In order to enable the flat plates 26 to be securely attached to the honeycomb structure, non-woven fabric sheets 24 may be attached to the honeycomb structure by means of adhesive, prior to the attachment of the flat plates 26. Thus, a honeycomb structure having a desired size and superior quality can be produced in accordance with attachment of flat plates of various materials.

In honeycomb structures produced in accordance with conventional methods, a releasing phenomenon may arise because the bonding area of the honeycomb core to the flat plates is too small. However, such a releasing phenomenon may be greatly reduced in the present invention because the bonding area of honeycomb core to the flat plates is large.

Furthermore, in accordance with the present invention, a honeycomb structure having dense hexagonal cells can be easily produced without using complicated processes, by forming hexagonal cell metal plates having hexagonal pegs, using moulds, and overlapping and coupling the hexagonal cell metal plates such that the protruded surfaces of the metal plates face each other.

In accordance with the method of the present invention, it is also possible to fabricate a firm honeycomb structure, using a metal material having a high compressive strength and a high bending strength.

ABSTRACT

A method for producing a honeycomb structure is disclosed which includes forming two hexagonal cell metal plates each having uniformly-spaced hexagonal pegs, using a mould and a press, applying a fusing material or strong adhesive to outer surfaces of the hexagonal pegs, and overlapping the metal plates such that surfaces of the metal plates, from which the hexagonal pegs are protruded, face each other, and coupling the metal plates such that adjacent ones of the hexagonal pegs of the metal plates are engaged, thereby producing a honeycomb structure having continuously joined cells.